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Valuation of Natural Gas Storage:

A Discussion of the Value of Storage Gas and Implications for Public Policy

Presented to:

California Energy Commission
Staff Workshop on
Natural Gas Storage Research

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Material presented is drawn from preliminary results of research conducted under Task 1, Conceptual Analysis of the Valuation of Storage from Public and Private Perspectives, California Energy Commission (CEC) PIER Natural Gas Program.

The views presented here are the views the Author and do not reflect the views of CIEE or members or staff of the California Energy Commission.

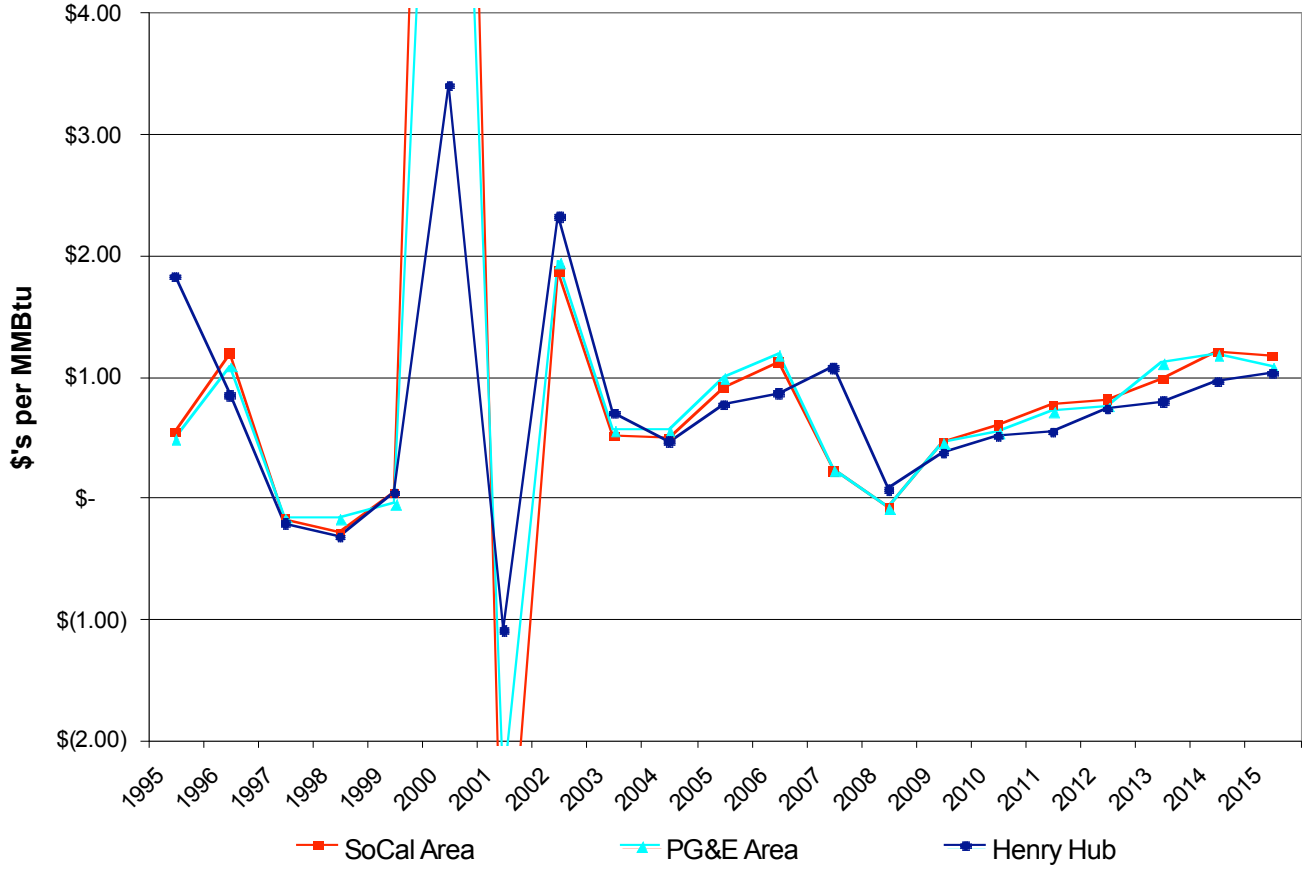
Agenda

- A discussion of the elements of the value of storage.
  - "Intrinsic" value.
  - "Extrinsic" value.
- California storage in the context of the North American gas market.
  - Competitive alternatives to storage.
  - Impact of weather.
- Externalities associated with natural gas storage.
- Issues and implications.

What is the Value of Storage to Participants in Storage Transactions?

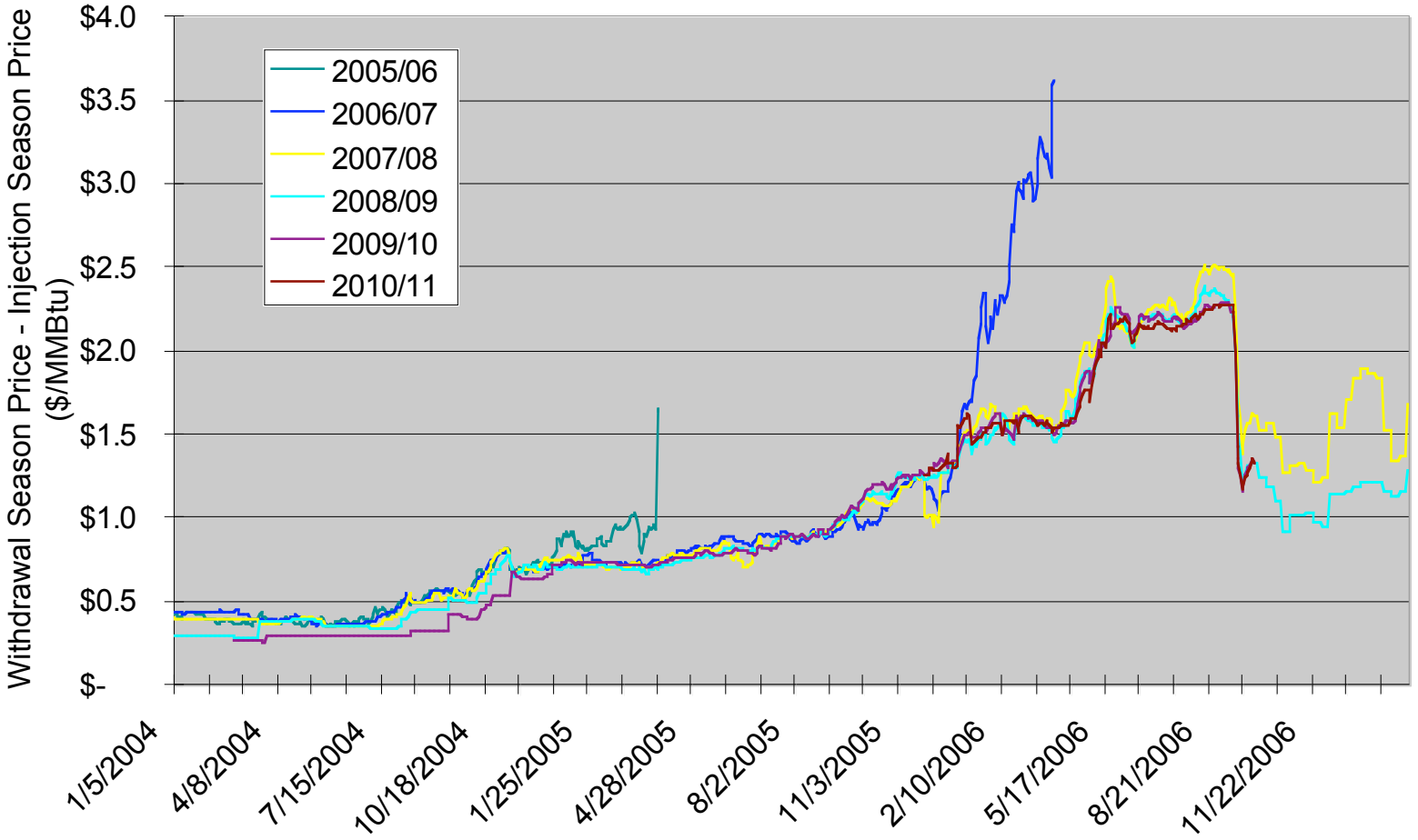
- "Intrinsic" value of storage.
  - The value of gas withdrawn from storage minus the cost of the gas injected.
    - The seasonal price spread measured "after the fact" using actual prices.
- The "intrinsic" value of storage is driven by:
  - The seasonal difference in the supply-area gas prices.
    Plus
  - The seasonal difference in pipeline transportation value.
- "Extrinsic" value of storage.
  - Other factors that add (or subtract?) from the value of storage to a customer.

Historical and Projected Seasonal Price Spreads in California



Seasonal price spreads do not consider variable storage costs, time value of money, optionality, and other factors influencing storage value.

Seasonal Value of Storage at Henry Hub Based on NYMEX Futures Strip



Storage Value Beyond Seasonal Price Spread

- Mitigation of asymmetric market risk, (e.g., weather risk).
- Supply security in a "tight" market (Reliability premium).
- Impact of storage on utilization and value of other facilities.
- Provides flexibility needed to offer other services (parking, lending, etc.).
- Operational benefits that can reduce reliability/redundancy costs.
- Value of storage injections/withdrawals within a month. (Daily arbitrage)
  - "Risk averse" storage customers place little or no value on this element while "risk tolerant" customers can capture a large component of value.

"Extrinsic" Value

- "Risk averse" customers.
  - Reliability premium.
    - Insurance against market events.
  - Liquidity Premium.
- Ranges from ~ $0.15 to ~$0.25 per Mcf in the California and the Western United States.
  - Can be significantly higher in most constrained markets and market conditions.
- "Risk tolerant" customers.
  - Daily arbitrage.
    - Values are a function of deliverability of the storage.
- Increases from ~$0.35 per Mcf for 1.2 % storage to ~$2.25 per Mcf for 5 % deliverability for storage in the California and the Western United States.

Storage in the Context of the North American Gas Market

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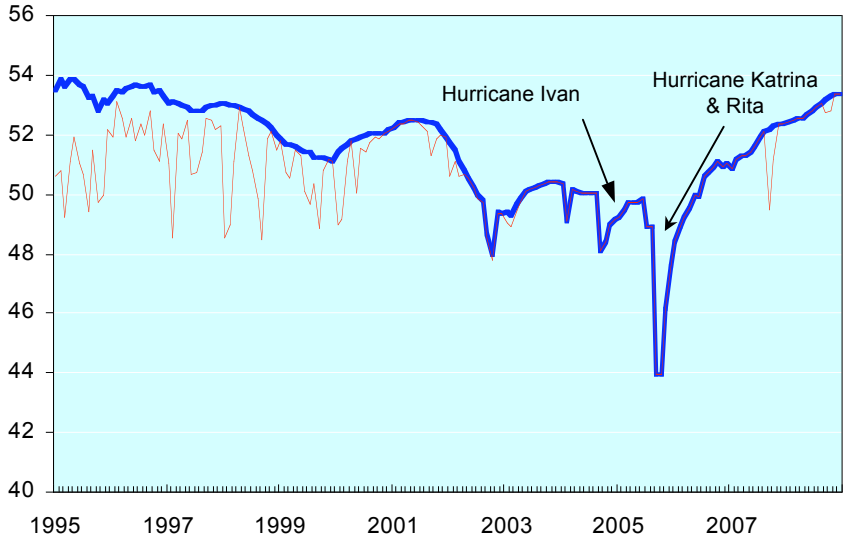
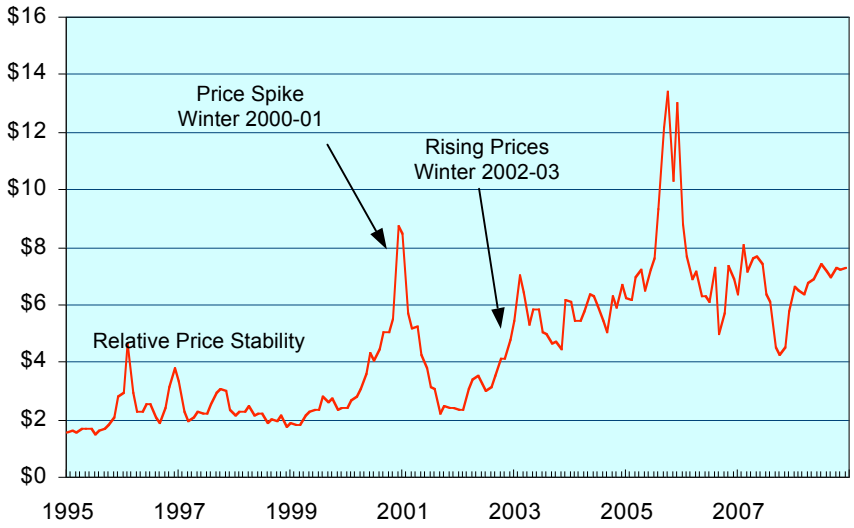
The Changing Gas Balance

Lower-48 Dry Gas Production Vs. Dry Gas Capacity (BCFD)



Source: Energy and Environmental Analysis, Inc.

Historical Gas Price at Henry Hub ($ per MMBtu)



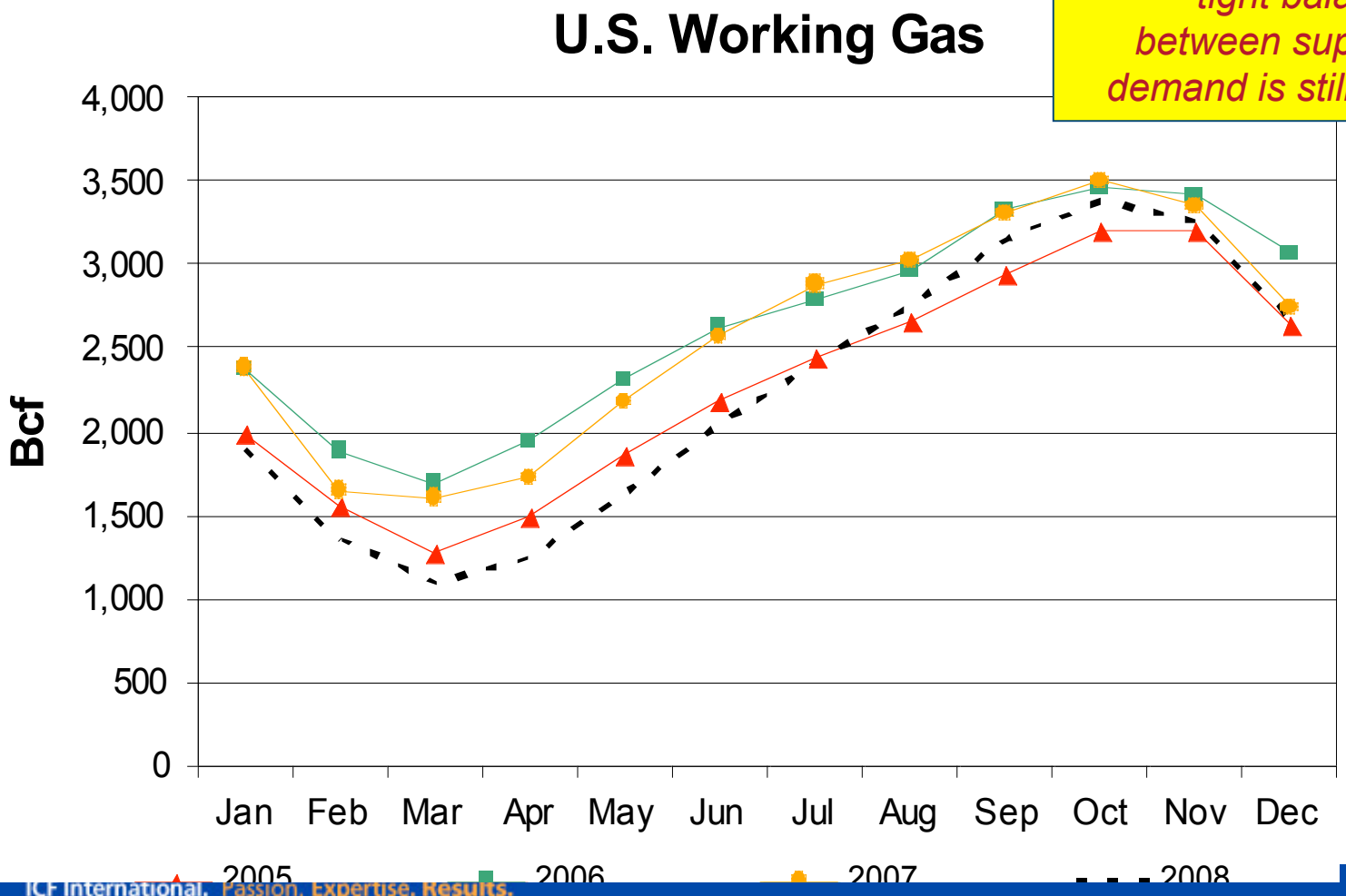
Source: Platts Gas Daily & Energy and Environmental Analysis, Inc.

Divergent trends in gas supply and demand have led to a tight balance between supply and demand, higher gas prices, and increased price volatility.

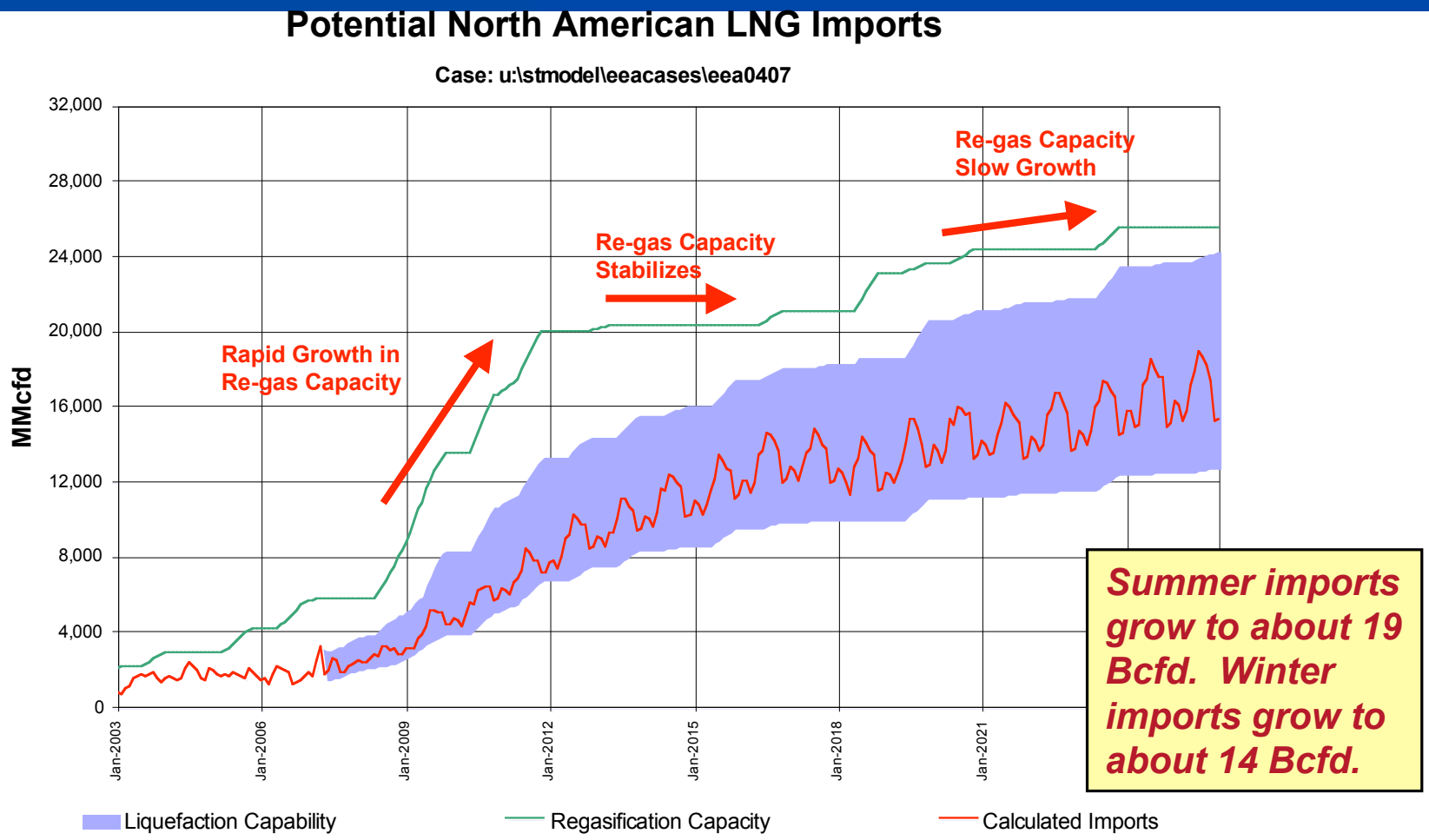
TIGHT BALANCE EXPECTED TO CONTINUE

Recent Gas Storage Trends

The fundamentally tight balance between supply and demand is still in place.



Seasonal LNG Capability Utilization



Summer imports grow to about 19 Bcfd. Winter imports grow to about 14 Bcfd.

Externalities associated with Natural Gas Storage

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Externalities Associated with Storage Transactions

- What is an externality?

An externality is a cost or benefit that is experienced by someone who is not a party to the transaction that produced it .

The concept of Externalities was formalized in Economic literature by Arthur C. Pigou in The Economics of Welfare, 1920

Externalities Associated with Storage Transactions

- Storage gas influences seasonal gas supply and demand and therefore the price of gas to all participants, not just the parties involved in the storage transactions.
  - Storage injections increase demand during off-peak requirement periods.
    - Supports/increases gas price levels for entire market.
  - Storage withdrawals increase supply during peak requirement periods.
    - Pressures/decreases gas price levels for entire market.
    - Reduces requirements for incremental pipeline upstream capacity.
  - Storage injection and withdrawal deliverability moderates daily price volatility.

Storage Capacity, Storage Gas, and Free-riders

- The external benefits of storage are not associated solely with the capacity of the facility, but in the gas that is cycled.
  - Would a "strategic gas reserve" in storage address this?
- Free-rider problem.
  - Would a mechanism promoting increased storage gas be offset by reductions in storage injections by private entities?

Issues and Implications for Public Policy

- If additional storage gas provides externality benefits, how should the incentives for altered behavior (i.e., increasing storage gas) be created?
  - Does there need to be a mechanism or does Coarse's Theorem prevail?
  - Does any mechanism necessarily create free-rider problems that exceed the public policy benefits of "internalizing" the economic externality?
- Would the public perceive/understand the issue sufficient to facilitate (or at least not impede) an acceptable solution?

Issues and Implications for Public Policy (continued)

- While a mechanism to directly affect the utilization of storage faces a number of complex challenges, research and development that addresses technical issues and costs of storage development and/or operations will indirectly foster additional storage availability and utilization that can provide benefits to parties to storage transactions as well as gas consumers that are not direct participants to the transactions.